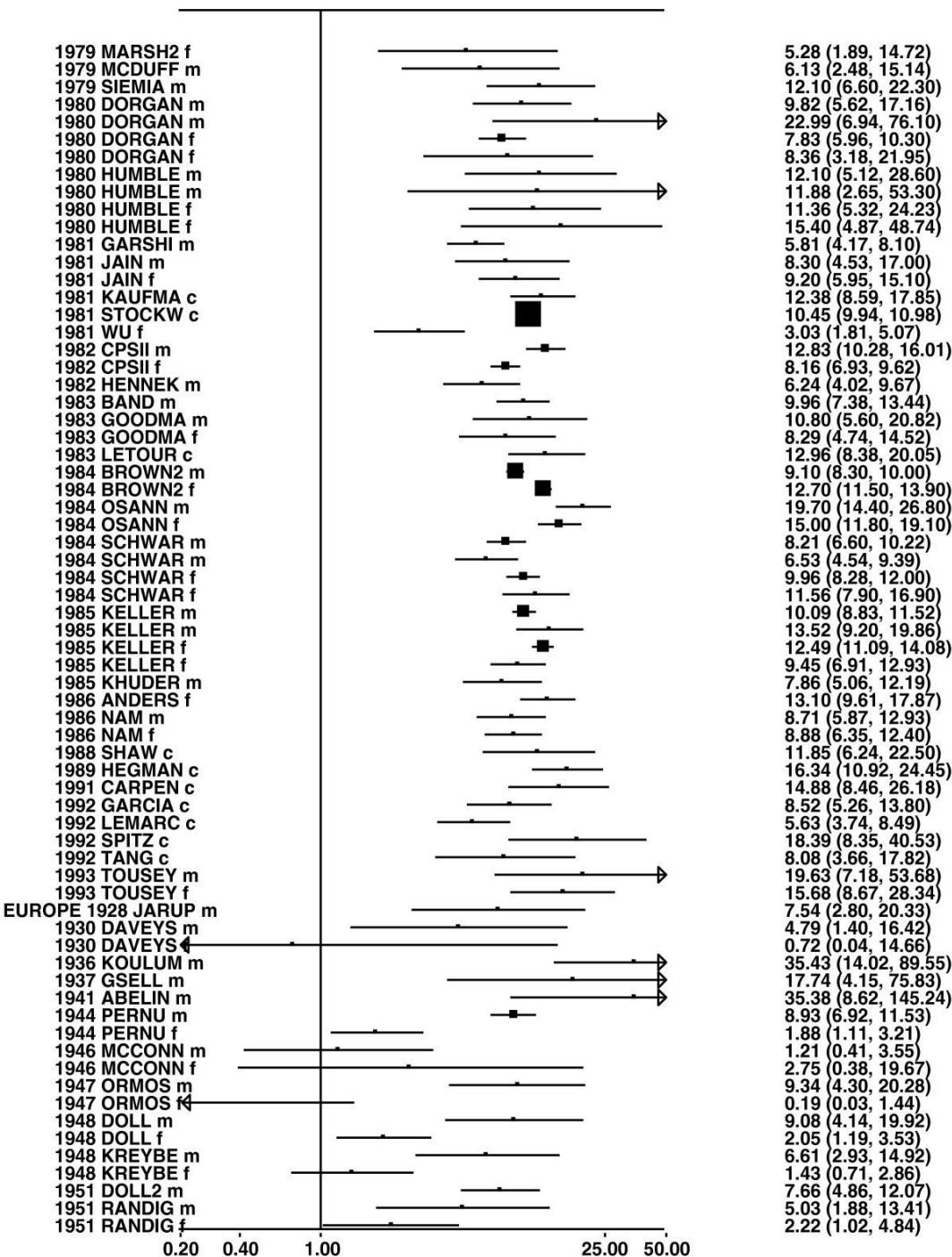




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22 Practical Considerations

This chapter discusses areas of technical and mathematical analysis that are not systems by themselves, yet essential to the successful development of a system. The first part concerns the use of the computer. Technical analysis and computers have become synonymous with each other and, with the simple steps provided by development software such as TradeStation, MetaStock, and spreadsheets, it would be rare to trade a new technical system without first running it through a computer to simulate its past performance. Those who do not use a computer directly are strongly influenced by the computer systems of others.

The second section, "Price Shocks," is the most underestimated deterrent in finding the right system and generating trading profits. This idea has been discussed in different places during this book, specifically in Chapter 21 in the section "Anatomy of an Optimization", yet it cannot be overstated. Unpredictable events, once they become part of price history, are often treated as though they could be anticipated. This can inflate performance returns and minimize risk during strategy testing with serious consequences to actual trading. This section will try to explain how to close the gap between testing and trading.

The Theory of Runs is actually an application of gambling techniques, primarily Martingales, to trading. What would seem more reasonable than assuming that the odds are against you in the futures market or as a shortterm trader and treating it as a gambling situation? The third section is about combining systems together that focus on different market characteristics, and the understanding of the tradeoffs inherent in each type of analytic method. There is also a short analysis of trading limits to show some of the problems and flaws of moving from a test to an operating environment. The last section reviews the similarity of systems and the impact of technical systems on futures markets.

USE AND ABUSE OF THE COMPUTER

Make sure your present report system is reasonably clean and effective before you automate. Otherwise your new computer will just speed up the mess.

Robert Townsend¹

Computers are not a substitute for thinking. They excel in performing the same tedious task, over and over again, quickly and accurately provided, of course, that correct information was entered. But even though technology has not yet reached the stage depicted in Star Wars, the computer is the only practical tool for evaluating trading ideas. This section will consider both good and bad ways to approach a computer problem, none of which can be credited to or blamed on the machine. As a powerful tool, a computer can't be beat many of the systems, advancements, and refinements presented in this book could not have been considered without it.

Computers come in many shapes and sizes, and can be purchased, leased, and borrowed. Their packaging has become second only to the car. During the 1980s, the average life of a computer generation was about 10

years; however, advances in technology have
Robert Townsend, Up the Organization (Knopf, New York, 190. p. 36).

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reduced that to about 3 years, if you don't mind a year when you feel obsolete. The past few years have seen a remarkable evolution in the computer industry. From an acceptance of the personal computer (PC) to the point at which some households would rather give up their television than their computer, the PC has revolutionized data processing and brought the Internet into tens of millions of homes. Because not everyone knows how to program a computer, software companies have developed turnkey packages, programs that are userfriendly, operated primarily by menu selection. The combination of these two factors, cheap hardware and sophisticated software, has reached far into the realm of individual and institution investors.

One of the first and foremost organizations to provide convenient computer research tools for the trader was the Technical Analysis Group (TAG), which began in 1975 as a user's group. It provided menu-driven capabilities for analysis of daily price data and programming capability similar to a spreadsheet using its CompuTrac software. It provided daily automatic updates of data at a time when that luxury was the state of the art. The company that breaks ground is not always the one that survives the race, and those analysts developing systems now expect much more. Generally, development software falls into two groups:

1. Daily market analysis, with price updates at the end of the day
2. Intraday trading platform, providing users with online data feeds to execute their strategies

Both types of software provide the ability to enter your trading strategies and test them on historic data. The software that operates on daily data is considered offline and is used by traders who prefer to evaluate the market after it closes and prepare orders that can be executed the next day without having to constantly watch the market. The intraday trading platform is much more complex and more expensive. It requires active data feeds and provides both realtime graphics and generates trading signals at the close of each price tick or bar, as defined by the user.

Acquiring Data

Daily historic data, essential to the development of trading systems, is readily available and most often comes with the purchase of the software. It is common to see 25 years of historic data on all U.S. markets, but not as common to have European and Asian data provided as well. Intraday data is available from a few major vendors and can be easily obtained for at least 15 years on U.S. markets, but is also much more difficult to get on markets outside the United States. Occasionally, there are sales on this data, and it can be purchased at a reasonable price. The Chicago Mercantile Exchange has made most of its tick data available on compact disk, but it is necessary to convert their form into one that can be read by your trading strategy software.

Of the non-U.S. firms, London's LIFFE has been providing tick data for the longest time, and 10 to 15 years is available for their oldest markets.

France's MATIF is just now providing tick data, as is Germany's DTB, Singapore's SIMEX, and many other exchanges. The form of the data provided is very similar, but all of them are incompatible with the trading strategy software and require what is called data reduction. Because the exchanges have taken the policy that providing data facilitates trading on their markets, there is usually no cost for it; this gives you some latitude to pay a programmer to write a program to convert this into your own format.

Cleaning the Data

Occasionally, you will find that your strategy was immensely profitable, or lost much more than you expected. When you test 20 years of data, you may not look at each trade

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but accept the results as correct and rationalize the outcome as a sequence of bad or good trades. You might be surprised to learn that there can be many erroneous prices in your data. It is an incredible waste of time to use data without first reviewing it to find errors.

Tick data is notorious for including bad data with the good, simply because of the magnitude of the problem. Most daily data is already clean. The easiest approach to checking your data is to display it as a chart and scan through all of the markets that you plan to use. Bad data points are obvious once seen on a screen. A low price of zero will show up as a vertical line going to the bottom of the chart; this will result in the correct data points being scaled down to look as though they are just a horizontal line. You can then find the date of this point and correct it (provided your software has a correction feature).

if you can program the computer yourself, you will want to scan the data looking for outliers, those data points that are at least 10% away from the previous data points. The data provider should have prescanned the data to be sure that there are no intraday prices that were outside the endofday high and low prices transmitted by the exchanges, but this is not usually the case, and you will find that the most obvious errors have been overlooked. There are more subtle errors that can be found and corrected, but the largest ones must be fixed before you use the data. For testing, even one error per year is enough to make all of the tests useless. Don't forget that, if you remove a price instead of correcting it, you must reduce the tick volume as well.

Data Updates

It is not difficult to remember when all traders kept a copy of the Wall Street journal and clipped the price pages so that data could be entered into their computer. These pages, kept in a file drawer, became their historic database and absolute reference. This doesn't make sense any more. Automatic endofday updates are available to anyone at very little cost. They provide complete and accurate data as well as correcting any past data that might have been wrong. Some exchanges post daily prices on their Web sites and can be retrieved for free, but this requires added effort to convert that data into a form acceptable by your database. Most data providers will accommodate a number of different formats so that data received each day simply gets added to your historic data and is

immediately ready to use. Don't do it manually. Your time is best spent finding a profitable trading strategy rather than fiddling with data.

Archiving Data

Not only must you have a complete database of accurate, historic data, but you must keep that data current. Even if you have a live data feed, the data management of your system cannot store an unlimited amount of ticks or days before it begins to discard the oldest values. Most software will have a specific number of data points that it will hold for intraday data, and much more for daily data. For example, it is common to have only 3 months of tick or 15minute data, or the computer may hold 4,000 entries each of 1minute, 5minute, 15minute, and daily data, which mean about 16 years of daily data but only 4 months of 15minute data. This design may be important when you choose the system you use. By being aware of how much data is held, you will need to remember to archive the 15minute data before each 4month period elapses; otherwise, you will lose the data and your history will not be continuous.

Combining Standard Techniques into a System

Strategy development programs provide a wide assortment of standard techniques in the form of indicators and systems. You can pick a stochastic oscillator, a moving average, or

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an Nday breakout and combine them in various ways to evaluate markets over different time horizons, such as a 10day and 40day smoothing, or even vary the frequency of data using 30minute, 1hour, and daily bars. In most cases, you can write your own formulas to create customized indicators. If you experiment with these software features, you might find that they provide the ability to create a trading strategy that matches the time frame and risk profile that you want. For example, a longterm trend can be found with a standard moving average, weighted average, exponential smoothing, Nday breakout, or linear regression. All of these techniques are already available. You may want to combine that with a band to avoid whipsaws. That is also easily done. if you want to alter your timing so that you enter on a pullback after a trend signal, then you can add a stochastic or RSI to your rules. Before you begin specialized programming, there is a lot to be learned by using these standard tools. It is not at all clear that you can create a trend that is any better than the ones provided in your system. It may be that the choice of trend period is much more important than the trend technique.

Choosing Hardware

in an era of remarkable advances in technology, the hardware costs no longer seem an obstacle. As each new, faster chip is introduced, the previous model computers are reduced in price. This process seems to be happening at least once each year. The cost of a computer with a maximum configuration is small compared with your objectives, and not much greater than one trading loss. Because hardware has a shorter shelf life than only a few years ago, buying the biggest and best equipment is the only way to extend the life of your purchase.

The process of testing your strategies by optimization is a

computationally intensive method for the computer. You'll want to have the fastest processor. In addition, testing may still take one or more uninterrupted hours of data crunching; therefore, you'll want to have a large RAM to allow that process to go on in the background while you use the computer to do some other tasks. Institutional users will find it more practical to have one or more machines dedicated to testing. This will allow the calculations to continue at a predictable pace, rather than being interrupted by demands from other programs.

Programming the System

Computer programming talent is no longer rare, but in high demand. In addition, understanding a trading strategy is a special talent that requires training. Fortunately, the most arcane parts of system development are already part of any trading development software you buy. therefore, it is only necessary to code the actual strategy, rather than how to retrieve and store prices from the exchange data feed.

The prevailing philosophy about software development is to try to use as much thirdparty software as possible. if you need to see the results of a TradeStation optimization, save the results to a spreadsheet, then sort, organize, analyze, and graph the results using your favorite spreadsheet. You can compare one set of tests with another if you save them all in the same format. For the more popular platforms, such as TradeStation and MetaStock, there are a number of user's groups, support groups, and newsletters that can be of great help. Some companies provide alternate statistical measurements for your tests, while others have an addin portfolio program. It is a good idea to check to see if these services satisfy your needs before attacking the programming yourself.

Selecting a Programmer

If you are not going to program the computer yourself try to find someone with experience in a language similar to the one you'll be using. It would be helpful if the programmer had some knowledge of trading, which might avoid errors caused by misunderstanding con

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cepts, but that is not likely to happen. Given a choice, a scientific background is better than business programming experience.

Getting a programmer to say how much it will cost or how long it will take to solve a problem is going to be difficultthey just don't know. Programmers are incurable optimists, always thinking that the problem will be done at any moment. Even competent managers of programmers have difficulty in scheduling a project, based on the uncertainty of the debugging, or checkingout process. If it is necessary to contract the work or hire a programmer, try to get a fixedprice quote and avoid the problems that will occur later.

Define the Steps

To keep the work on schedule, you will need to know what you want to do in advance. You can take a chart and mark the places where you believe the system will buy and sell. It is important that you have an actual example of what is expected so that you can verify the programmed results against the example.

Write down all the rules in outline form. You must be able to be precise about every rule. The computer cannot deal with ambiguities. It is very likely that a programmer can work directly from your rules to create the final strategy. This is also an opportunity to be sure that your rules are clear and complete. Using your rules, select a price series and mark the trading signals that will be used to verify the program output. Check the results carefully. If one trade doesn't match your expectations, don't stop until you find the reason.

Looking into the Past

We have already thoroughly discussed the advantages of using as much data as possible; the results reflect a broader variety of market conditions and are, therefore, more representative. There is often a concern that older data does not represent current conditions. While there may be some truth in that, there is usually more to be gained with a system that can survive those years and still perform well in current markets. Unless there has been a structural change that makes the old data invalid, you should always favor longer tests and more data. Even if you are convinced that the older years represent a period of low volatility that will never be seen again, your system should, at the very least, not post losses for that period.

Paper Trading

With all good intentions, when you develop a new strategy you plan to hold the most recent data aside for out-of-sample testing. Somehow, before you're done, that data has been used a number of times. Therefore, as careful as you have tried to be, it is possible that you have overfitted the data by fine tuning the rules and parameters.

The only alternative is some period of paper trading. By monitoring the program daily, you can see how it is performing under real market conditions. Before doing that, however, you should write down the system expectations, for example, the size and frequency of the profits and losses. It is always a relief when the system posts its first profit, but it is the overall profile that is most important. When paper trading, assume that your fill is the worst price of the 5-minute period immediately following an intraday signal, or the highest price of the closing range if your trades come at the end of the day. A touch of reality can start you thinking and save a lot of money. Don't start trading a new system without monitoring its performance first.

Dealing with the Unexpected

By the time a computer and database have been acquired and installed, you have programmed or had a programmer implement your ideas, debugged and tested the programs,

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and finally analyzed the results, there has been a substantial investment made. Hard work has resulted in proving one of four things:

1. The system is profitable.
2. The system is not profitable.
3. The system cannot be implemented effectively.
4. The whole process is too expensive.

If you've gotten to the end and your result is not satisfactory, you

might want to reexamine the process that you used. Trading strategies should be built slowly; each piece must be proved to be sound before you go on to the next step. You should never have gotten to the end without knowing that the final product was going to be profitable. If the performance was deteriorating as you added new rules and features, you should have stopped and reconsidered these features and modified each step to be more robust.

You may also find that your rules were too subjective, that you substituted a rule that was not well thought out, because you were not able to clearly define one part of your strategy. Knowing that you have been subjective about a trading decision is a valuable discovery. Many speculators believe that they are very clinical about their trading policies; they know exactly what will be done in every circumstance and, therefore, think that their approach can be well defined in writing. But computerization cannot be done successfully if there are any "maybes," "wait and see," or any other exceptions.

one common problem is that the system does not work using either the rules or the variables imposed by the program. if moving average periods ranging from 20 through 50 were first used unsuccessfully, it is likely that you would test intervals of less than 20. if stoploss points were too big or too small (judging by the size of frequency of the losses), you'll try other sizes. Systems do not always work as expected and perhaps only a slight change to the rules is necessary. Negative results are important feedback. They can help create a better strategy before it is too late. After all, if the answers were known in advance, this would all be unnecessary. If the results are good, but different from what was expected, you should take the time to understand why. Don't accept the results without careful review. This is an opportunity to either increase your understanding of how the market works, or find that you have been making a mistake all along.

A common result is that the system works in some markets but not in others. This can be the product of using fixed values rather than a rule. For example, a stoploss of 4 ticks would make sense for Eurodollars trading at 4% yield, but not the S&P at 1100. Try to locate the problem and make the rules more adaptable to changing conditions. Once this is done, if the problem persists, you must face the issue of robustness.

Expectations

In some work, defining your expectations can bias the process and give poor results. For the development of a trading system, you must first have a sound idea before you start. Along with this idea is whether it works best in the short or long term, the frequency of profitable trades, and even the size of the expected profits and losses. By defining your expectations you can apply special rules and techniques that seem consistent with the philosophy of the method. These expectations of the profit profile are particularly important to keep you focused throughout the development and testing of the strategy. If you expect to trade one each day and capture about 50% of the trading range, then signals that occur only once each week should immediately cause you to look for an error. If profits are too small or losses too big, then you can carefully study how the rules apply to

a series of prices and understand whether you have omitted some rules, applied the rules incorrectly, or have made a mistake in your thinking. Without setting down clear expectations in advance, you have no benchmark to help you through the development process.

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A Winner in Disguise

One important twist on performance should not be overlooked: A consistently bad performer can become a consistent winner by doing just the opposite. Finding a profitable trend system in the range of shorter time intervals may seem to be a hopeless effort. On the other hand, systematic losses mean that the price movement fails to trend, and every buy signal and sell signal is actually an overbought and oversold condition, predictive of price change. This can happen in markets that are heavily traded using systems.. what appears at first to be a trend change is a temporary distortion due to massive buy and sell orders.

Consistent losses do not always mean that the reverse trade will work. The net losses may be less than the total transaction costs; therefore, the opposite action will show even larger losses. The successful reverse system is one in which the net losses far exceed the transaction costs.

Simple or Complex?

It is not necessary to create or acquire a system that is exceptionally complex to be successful. Simple systems, such as a dual moving average crossover, can be profitable as well. The difference between the performance of a simple system and a welldeveloped, complex method is the risk/reward ratio and the magnitude of the equity swings.

Simple systems will catch the trends and take as much profit from the big moves as the more sophisticated approaches. It is the other patterns that make distinctions. Added features should reduce the losses and modify the trading patterns during nontrending periods. This may be accomplished by identifying a trading range, using positions of varying size, or by the inclusion of economic data. Sometimes, more complex systems are just more complex, without improving results. In that case, use the simple system, but retain larger reserves than normal. just Because It Doesn't Work in Practice Doesn't Mean It Won't Work in Theory

You thought that you followed all the rules by

1. Precisely defining the system
2. Using enough test data
3. Evaluating performance by forward extrapolation
4. investing enough to survive the worst losing streak
5. Trading a diversified portfolio
6. Following every signal

And still you lost all your money... What happened?

Most likely you skipped some part of the wellplanned development process. Careful reassessment will usually show that some corners were cut. For example, new traders often only test their ideas in general by spot checking a few selected markets during years that seem to have interesting or typical movement. They assume that these shortcuts do not affect the results of the system. The advantage of computerized testing is that all

years can be tested easily the procedure necessary to produce a robust system that works in most markets.

There is always the temptation to force a system to work if it failed because of one or two large losses. An analyst can find something unique about these losing trades and create a rule that eliminates just those items. Some traders may just assume that circumstances would have caused them to pass the trade rather than buy or sell in an obviously adverse market. This type of tampering doesn't work and the reason for many of these problems is explained in the next section on price shocks.

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Suppose you are not guilty of any of these infractions, that the system was developed without making exceptions, and all the rules were followed. Then, the most common problem is to misjudge the volatility of the market or some systematic change that has occurred. You might see that the program was more profitable in the earlier years, and that the average profit has been declining and the average loss rising. This might be due to increased participation and more market noise. As this occurs, it is necessary to increase the period of calculation to compensate for the noise. For example, in the early 1980s, the energy markets were very smooth, and a 3day moving average generated good profits. As volume increased, the market appeared more erratic, and a 10 to 20day moving average would have been needed. In the early 1990s, the trend speed would have increase to 30 to 40 days, all due to changing market noise. When there is higher noise, it takes longer to identify the trend. Even when you sit still, the market will continue to change.

Start Slowly

After paper trading, to begin trading with an exceptionally small portfolio, one that can be lost 10 times over, will not hurt at the beginning. There must be a chance to see if the system performs the way it appeared in testing. This will be the first opportunity to find out the cost of execution. The slippage may be the factor that separates profits from losses. You may find that, during quiet periods, when the market is moving sideways, there is small slippage but no profits; during fast market, when you expect the largest profits, the slippage also increases. The size and frequency of the losses should be checked as well as the equity cycle. When everything passes inspection, the investment can be increased slowly. Patience and thoroughness are important ingredients for success.

Once the system has been checked out, it is even safer to turn the daytoday executions over to someone else. it may be the only certain way to follow the rules precisely. Try to stay detached and objective, but monitor the results carefully to be sure there are no surprises. Even a large profit may be an early warning of a problem. Large losses often follow large profits.

PRICE SHOCKS

Price shocks represent the most significant obstacle in the effort to close the gap between test results and actual trading, or expectations and reality. A price shock is, by circumstance, an unexpected event. Exceptionally volatile price moves are caused by actual news that differs

from expectations, such as the Fed raising rates by 1% when only VA was anticipated; or, it may be a significant, unexpected political event, such as the abduction of Gorbachev in 1991. The key word to remember is "unexpected."

If an event was expected, then there would be no price change. The market would have already moved to the anticipated level. Therefore, we cannot expect to profit from a price shock by clever planning, but only by chance. We should never assume that we would be on the right side of a large, unexpected move in more than 50% of those events. Unfortunately, when we backtest a trading system using historic data, we tend not to identify specific price shocks and treat them as normal, predictable events. We choose systems that perform best over a set of parameters, without regard to specific trades that may have been the result of shocks. We judge results by higher profits, lower risk, or a combination of statistical values. The results chosen as the best performance often have been the greatest beneficiary of these unpredictable price shocks.

Making Money with Hindsight

We should already be aware of the problems of backtesting. While there are no other alternatives for validating a proposed trading strategy, it is necessary to look at the problems

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more carefully to see a solution. No market is more evident than crude oil during the Gulf War, discussed in the previous chapter (see Figures 221, 222, and 223). From August 1, 1990, through the end of the War in February 1991, oil prices were driven by news. But not all news is a surprise. In the agricultural markets, a crop freeze in orange juice or coffee is often anticipated by a change in weather. Before a freeze can occur, the temperature must drop. And that low temperature must be sustained to cause damage. This weather change causes processors to protect themselves by buying forward contracts or futures. In turn, prices move up.

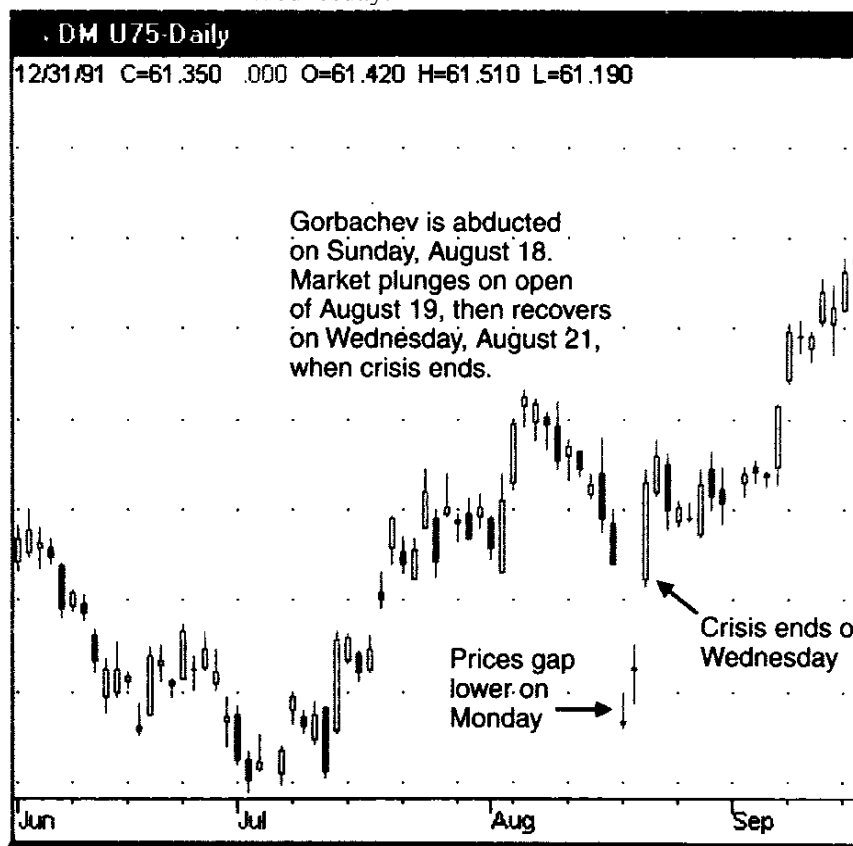
Because Iraq had been moving troops near the Kuwait border, their intentions were not a surprise; however, diplomacy failed. The threat of an oil supply disruption caused oil prices to slowly rise. Many systematic traders and commercials would have been long on August 7, 1990, when Iraq invaded Kuwait.

Identifying Price Shocks

If we can't predict price shocks, and they seriously impact our historic tests, then we must identify those shocks so that we can correct for their effects. In the end, this may mean that we need to look at the individual trades, compare them against a list of price shocks of which we are aware, and decide which of the profits were realistic. Even more important, we must decide which risk was understated. There may not be a safe way of changing this final process. It may always be necessary to manually review the results for credibility. Some analysts may find it comforting to think that the computer may not be able to do everything on its own!

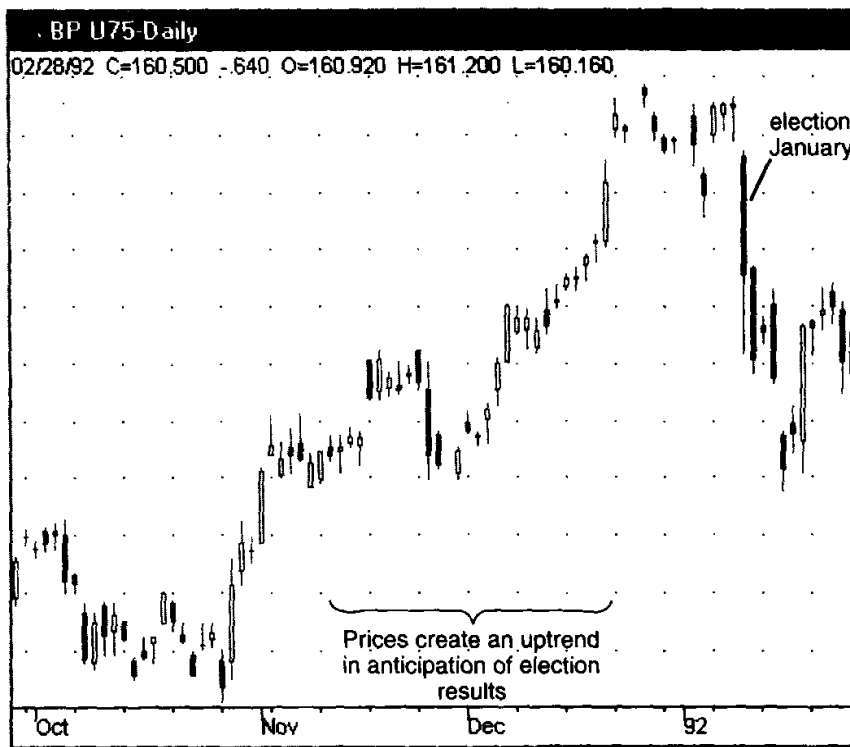
FIGURE 221 A far-reaching price shock. A vivid reminder of price shocks occurred on

August 16, 1991, and again 3 days later when Russian premier Gorbachev was abducted and then released. Most financial markets were affected simultaneously, as were the energy markets. In the case of the currency markets, many traders profited from the first shock, which occurred on a Sunday, then gave it all back on the following Wednesday.



Source: Chart created with TradeStation® by Omega Research, Inc.

FIGURE 222 A more common shock. The election of conservatives in Britain in January 1992 was a surprise, but the effect was relatively local.



Source: Chart created with TradeStation® by Omega Research, Inc.

The process of identifying price shocks can be speeded up with a small amount of automation. A price shock will be defined as a day with a true range greater than the average true range by a multiplier, called the shock factor. This would be coded as

```
shock = 0;
truerange = high - low;
if high - close[1] > truerange then truerange = high - close[1];
if close[1] - low > truerange then truerange = close[1] - low;
volatility = @average(truerange[1], vperiod);
if truerange > volatility * shockfactor then shock = 1;
```

Having coded the identification of a price shock, we can write a record to a file or print log to create a list of all price shocks, the date they occurred, and the size of the initial shock. It might also be useful to count the number of periods until prices return to a relatively normal level. It may

be unrealistic to assume that the volatility resulting from a price shock will completely disappear; therefore, the point at which some degree of normal might begin could be when volatility declines to onehalf the level of the initial price shock. This would be found using the code

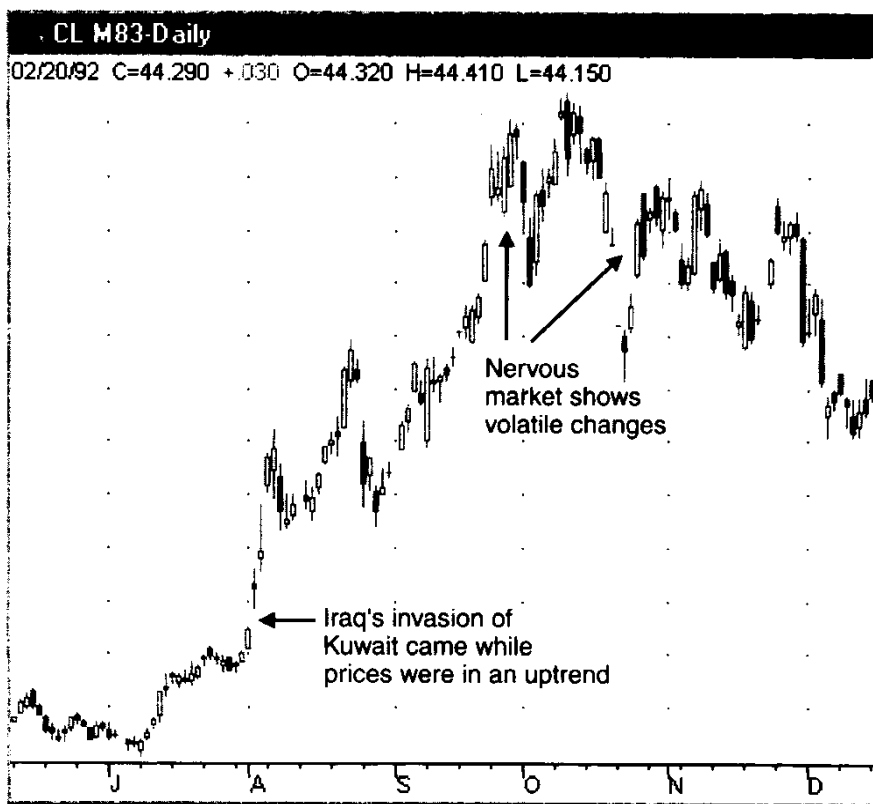
```
if truerange < shock/2 then shock
```

With this simple method of identifying both the beginning and end of a price shock, we can study the effects of price shocks on testing performance. A simple test was performed in which an optimized trend system was inspected for periods of price shocks, where a shock was defined as a price move of three times normal volatility. The profits and losses from these periods was removed from the net performance over a 10year period, with the results shown in Table 221. The reduction in profits was more than 50% when price shocks were eliminated. This means that the selection of parameters heavily favored profits that were generated by large, probably unpredictable, price jumps.

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FIGURE 223 The invasion of Kuwait by Iraq. News of massing armies and troop movements near the Kuwait border helped the market anticipate the August 7, 1990, price jump in oil.

At the beginning, many traders were on the right side of the market, although the move was not very dramatic.



Source: Chart created with *TradeStation®* by Omega Research, Inc.

How can we use these results if we cannot see the price shock until after it's happened? The only way is to correct the optimization process so that the parameter selection is not based on which calculation period is best tuned to get the most profit from these events. If you remove the profits or losses during the initial price shock from the historic test results, as shown in Table 221, the optimization would then show the best performers, net of price shocks. Because price shocks are unpredictable, selecting from a shockadjusted result should yield a better trading system. Some traders might also prefer to use the identification of a price shock period to change the current trading strategy to one of crisis management.

GAMBLING TECHNIQUE THE THEORY OF RUNS

The application of Gambling Theory to highleveraged or shortterm trading satisfies two important conditions. First, it presumes no statistical advantage in the occurrence of profits

**TABLE 22-1 Results of Removing Price S
10-Year Historic Performance**

	<i>Trend System</i>	<i>Adjus Sh</i>
Crude oil	17.12	7
U.S. Treasury bonds	9.85	4
Deutschemark	14.92	5
British pound	20.56	10
S&P 500	-3.50	-4

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and losses but concerns itself with the probable patterns. Each trade could be treated as an occurrence of red or blackup or down price moves or profits. Second, Gambling Theory stresses money management under adverse conditions. A successful professional gambler and an active trader must both be highly disciplined and conserve capital. This section will look at a gambler's approach to money management and risk, using the Theory of Runs.

If the assumption is made that each trade is unrelated to the previous trade or that each successive price has an equal chance of going up or down, the situation closely resembles roulette. In Monte Carlo, the roulette wheel has 37 compartments: 18 black, 18 red, and 1 white, assuring a loss of 2.7% in the same way that transaction costs are a handicap to trading. Continuously betting on only red or black will break even, less 2.7%, over long betting periods. The only way to change the odds is by money managementvarying the size of the bets. Although the variables in trading are more complex, we will look at this first.

The most wellknown method for winning in a gambling situation is based on the probability of successive wins, the Theory of Runs. On each spin of the wheel, the likelihood of the same color (red or black) reoccurring is 50%, or 1/2 (ignoring the white slot). To define a run of 3 reds, it is necessary to show a black on each side, that is, BlackRedRedRedBlack

otherwise, the run may not be complete. If each color had a 50% chance of occurring, the probability of a run of 3 is

$$\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \left(\frac{1}{2}\right)^5$$

one run of 3 can be expected for every 32 spins of the wheel (called coups). Extending that to runs of n consecutive reds gives $(V2)^n$. For 256 coups, which is both a power of two and the approximate number of trading days in a year (if you consider daily closing prices rather than intraday trades), there are the following possibilities for runs of red:

Run of Length	Probability of Occurrence	Expected Number of Occurrences
1	$\frac{1}{8}$	32
2	$\frac{1}{16}$	16
3	$\frac{1}{32}$	8
4	$\frac{1}{64}$	4
5	$\frac{1}{128}$	2
6	$\frac{1}{256}$	1

A run of greater than 6 is not expected to occur. The total number of occurrences of red is only 120, short by 8. These 8 are accounted for by runs of length 1 through 6, or become a run of 7 or 8. The probability of a run of length n is calculated using a geometric progression to get the sum $(\frac{1}{2})^{n+2}$, where $256 \geq n \geq 7$:

$$\begin{aligned}
 P &= (\frac{1}{2})^9 + (\frac{1}{2})^{10} + \dots + (\frac{1}{2})^{256} \\
 &= \frac{(\frac{1}{2})^9}{1 - (\frac{1}{2})} = \frac{1}{256}
 \end{aligned}$$

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There is a single chance that there will be a run greater than 6 in 256 tries. The average length of a run greater than 6 turns out to be 8, based on the decreasing probability of occurrences of longer runs. The average length of all runs greater than n will be $n + 2$. That makes the table of runs complete, with the number of occurrences of red equal to 128. Martingales and AntiMartingales

The classic application of the Theory of Runs is called Martingales. In the simple version of this approach, an initial bet is doubled each time a loss occurs; whenever there is a win, the betting begins again at the initial size. To demonstrate how this works, it is necessary to use a table of uniform random numbers (which can be found in Appendix 1). These numbers vary from 0 through 9. Let all those numbers beginning with digits 0 through 4 be assigned to red and 5 through 9 to black. Figure 224, read left to right, where open squares are red and solid squares are black, shows the first 257 assignments according to Appendix 1. Assuming that we bet on black, losses will depend on the longest run of red. We must decide the size of the initial bet in advance, which should be as large as possible and still withstand the longest run of red that is likely to occur. By using the results from the analysis of the length of runs, we find that for every 256 coups, it is likely that only one run greater than 6 will occur, and that run would most probably be 8 in length. The probability of a run of 9 is $(\sim/2)^9$, or 1 in 1,024. In 256 coups, the odds are about 3 to 1 against a run of 9 occurring.

Having decided that capitalization must withstand a run of 8, we calculate that a bet of \$1 doubled 8 times is \$128. Divide the maximum amount of money to be risked by 128 and the result is the size of the initial bet. Each \$1,000 divided by 128 gives 7.8125, which must be rounded down to \$7; therefore, on the eighth consecutive occurrence of red, the bet will be \$897. Counting the occurrences of runs on the simulated roulette table (Table 222), it is interesting to see that a run of 8, but not 7, appears.

The results are within expectations, and no runs greater than 8 occurred in either red or black. For the purposes of this example, the betting would then proceed as shown in Figure 2 25, using an initial bet of \$ 1. The numbers in the squares represent winning bets.

FIGURE 224 Sequence of random numbers representing occurrences of red and black.

COUPS GENERATED FROM RANDOM NUMBERS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	□	□	□	□	■	■	■	□	■	□	□	□	□	□	■
2	□	■	□	■	■	□	■	□	□	□	■	■	■	□	□
3	□	□	□	□	■	□	■	□	□	□	■	■	■	□	□
4	□	■	□	□	■	■	■	□	■	□	■	□	□	□	□
5	■	□	■	■	□	□	■	■	■	■	■	□	■	□	□
6	□	■	■	■	□	□	□	□	■	■	■	■	□	■	□
7	■	□	□	□	■	■	□	□	■	■	□	■	■	■	■
8	□	■	□	□	□	□	■	■	□	■	■	■	□	■	□
9	□	■	□	□	□	□	■	□	■	■	□	□	□	■	■
10	■	■	□	□	□	□	□	■	□	■	■	■	□	■	■
11	■	□	□	■	□	■	■	□	■	□	□	■	■	■	□
12	■	□	■	■	■	□	□	■	■	□	■	■	□	□	■
13	■	■	□	■	□	□	■	■	□	■	□	■	□	□	□
14	□	■	■	■	■	■	□	■	□	□	■	■	□	■	■
15	□	■	□	□	□	□	■	□	■	□	■	□	■	■	□
16	□	□	■	□	■	□	□	■	■	□	■	□	□	■	□
17	■	□	□	□	□	□	□	□	□	■	□	□	□	□	□
18	□	■													

TABLE 22-2 Simulated Runs

<i>Red</i>	<i>Black</i>
35 runs of 1	35 runs of 1
12 runs of 2	14 runs of 2
7 runs of 3	11 runs of 3
7 runs of 4	3 runs of 4
2 runs of 5	2 runs of 5
2 runs of 6	
1 run of 8	
138 total occurrences	118 total occurrences

Every occurrence of black is a winner. Although \$64 is actually won on a single black coup, each sequence of runs nets only the initial bet because of the accumulated losses during that sequence. For the 256 coups shown in Table 222, there were a total of 65 distinct runs resulting in a profit of \$65 (or \$455 based on a \$7 initial bet), or about onehalf of the initial capitalization (\$ 128 or \$ 1,000, respectively). Instead of using Martingales, if we had used the benchmark strategy of betting equal amounts on black to win on every coup, we would have lost \$20 on a \$1 bet. The Martingales method, therefore, has a good chance of winning a reasonable amount.'

AntiMartingales

The antiMartingales approach offers a smaller chance of winning a large amount; it is exactly the opposite of applying Martingales. Instead of doubling each losing bet, the winners are doubled until a goal is reached. Because there is an excellent chance of 1 run of 6 in 256 coups and a similar chance of a longer run, this method wins if the long run occurs in the first half of the number of coups to be played (256 in this case). Once a run of 6 occurs, you must immediately stop playing.

We already know that a run of 6 returns \$32 on a bet of \$1, and a run of 8 nets \$128. This method would have lost if it had been applied to black in the test sequence; because there were 138 red coups with no black runs greater than 5, there would have been a loss of \$138. If the bet had been on red, looking for a run of 6, there would have been three wins, each for \$94, and a loss of \$118 for that many appearances of black. Waiting for a run of 8 would have won \$128 and lost \$117 on black by stopping right after the win. The success of antiMartingales depends on how soon the long run appears. In 4,096 coups, a run of 11 will occur once, returning \$1,024 on a bet of \$ 1. In the same 4,096 spins, there will

The Martingales approach is likely to work if the player could withstand adverse runs of 11, but casinos

tend to limit bets to amounts significantly less than 2ⁿ times the minimum bet,

FIGURE 225 Betting pattern.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	2	4	8	16	1	1	1	2	1	2	4	8
2	1	2	1	2	1	1	2	1	2	4	8	1	1
3	4	8	16	32	64	1	2	1	2	4	8	1	1
4	4	8	1	2	4	1	1	1	2	1	2	1	2
5	16	1	2	1	1	2	4	1	1	1	1	1	2

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be 2,048 losses, showing that if the long run happens in the middle of play, the method breaks even; if it occurs sooner, you win.

The Theory of Runs Applied to Trading

Before applying either Martingales or antiMartingales to the markets, it must be determined whether the movement of prices up or down is as uniform as in the case of roulette. A simple test was performed on a combined set of 21 diverse futures markets. The combined results of all up and down runs are shown in Table 223. The expected occurrences of both up and down were twice the probability of either a red or black coup occurring.

Some differences between the random pattern previously used and actual results can be seen in Table 223. These futures markets show fewer runs of 1 and more frequent runs of 2; their tendency to fluctuate in a narrowing pattern around the expected (random) length of a run (Figure 226) may be due to the smaller sample of longer runs. The probabilities found here might be used to decide the chances of the next trading day continuing in the direction of the prior day's trend, noting that a 3 to 4day run is as long as might be expected. The most interesting applications are in the betting strategies of the Martingales and antiMartingales methods, applied to futures markets. The following sections show two possibilities. Trading Daily Sequences

By combining the Theory of Runs with the direction of the trend, the chances of being on the correct side of the longest run are increased., and, the size of the price move in the direction of the trend may also tend to be larger. To give yourself the best chance of identifying the trend, it should be longterm. Assuming that the trend is up as determined from a chart or moving average, enter a long position on the close of a day in which the price moves lower.

If Martingales is used, double the position each day that prices move adversely. A single day in which prices move up should recoup all losses and net a reasonable profit. If the trend is sustained, there should be fewer days down and more days up, thereby yielding a better return to

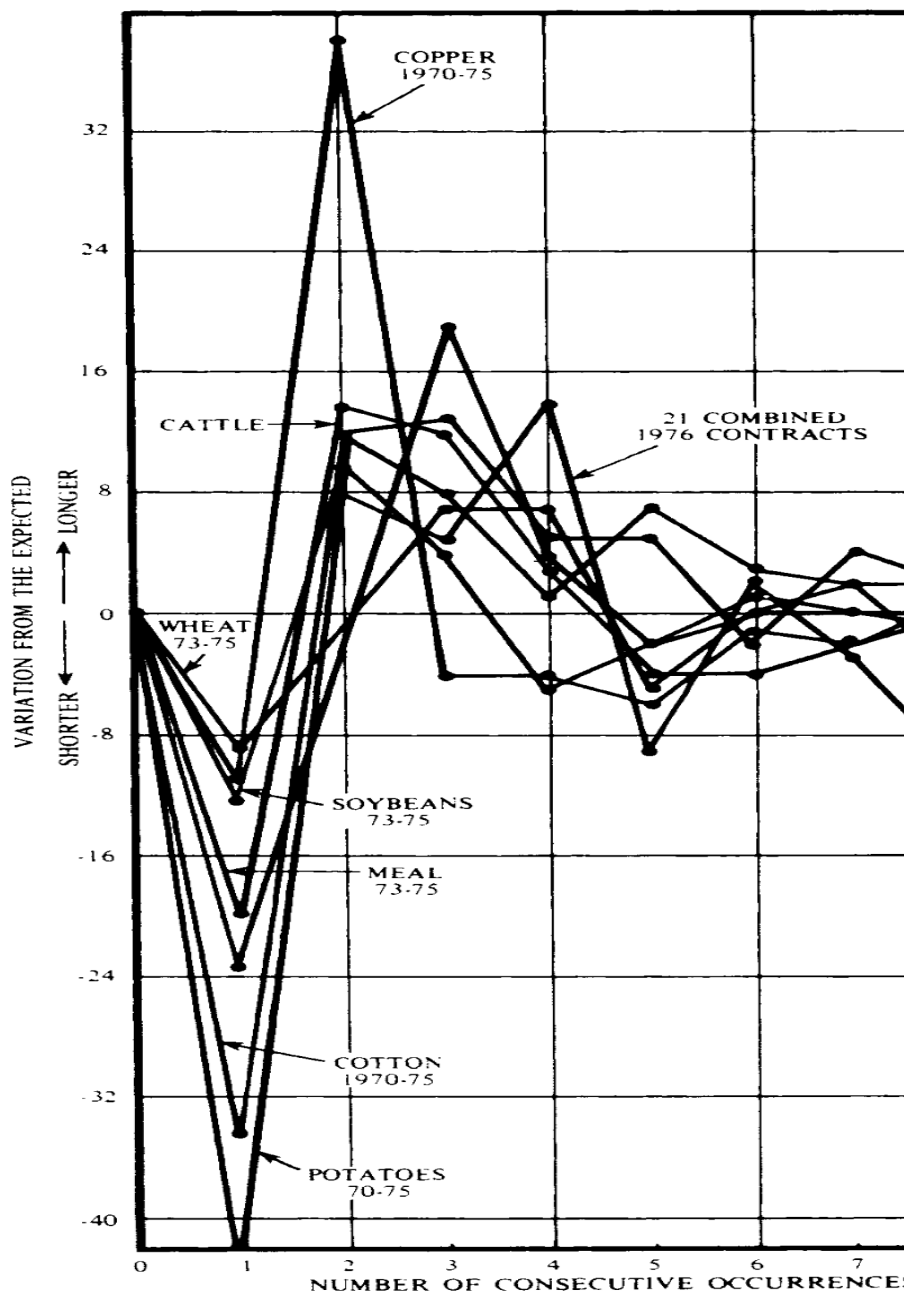
capitalization ratio. A variation on Martingales might include holding the trade for 2 consecutive days in the profitable direction because of the bias shown in the distribution of runs. Another variation would take profits while prices are moving in a favor

TABLE 223 Expected Occurrences of Ups and Downs for a Diverse Set of Markets

<i>Length of Run</i>	<i>Expected Probability of Occurrence</i>	<i>21 Markets Con Expected</i>
1	1/2	1,225
2	1/4	612
3	1/8	306
4	1/16	153
5	1/32	77
6	1/64	38
7	1/128	19
8	1/256	10
9	1/512	5
>=10	1/1,024	4
Total tested		

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FIGURE 226 Actual futures movement compared with random movement.



able direction and set new trend positions after 1 or even 2 days of price reversal. Either variation might improve the return ratio after a random occurrence of runs.

For the antiMartingales approach, double the position after each profitable day, take profits after runs of 3, and begin again after a reversal day. By trading with the trend, profit sequences may be increased to 4 days; it may also be expected that, on average, the price change will be smaller on days that move counter to the trend.

System Trading

A standard trendfollowing system can expect 30% to 40% successful trades (called its reliability) of varying profitability, which can be defined in terms of a profit/loss ratio. In considering the Martingales or antiMartingales methods, it should be noted that the lower probability of profitable trades would make the wait for a long run of profits less attractive. If a system has a profile of 35% successful trades and a profit/loss ratio of 3 : 1, then trading equal amounts on each signal results in the following, assuming \$750 each profit and \$250 each loss:

Total trades 100 x \$25 (commission) = \$2,500

Profitable trades 35 x \$750 = \$26,250

Losing trades 65 x \$250 = \$16,250

Net (\$75 per trade) \$7,500

Taking these same figures and applying Martingales to a uniform sequence of two losses and one profit gives \$275 as the first loss (\$250 plus a \$25 commission), \$550 for the second loss, then \$2,175 for the profit, netting \$1,375 for three trades, which would return \$229 per contract traded.

The disadvantage of applying Martingales to the irregular returns of highleverage markets is that a long run of losing trades requires a large amount of capital. If it is necessary to keep a large reserve in the event of a long run of losses, why not simply trade equal amounts of a larger position on each signal, without using Martingales? A sound trading strategy should differ from a pure gambling situation because a specific system will win in the long term, while you will lose at roulette. The results show that trading the same larger position on each signal will return a higher profit than an application of Martingales, which requires the same available capital; however, a less aggressive betting method that assumes favorable odds can improve the return on investment.

In another study of applying Martingales, an actual trading system based on Wilders RSI was used to create buy and sell signals.¹ During the test, a total of 277 contracts were held at one point, which is far beyond the realm of the normal speculator. That means an investment of 277 times the initial margin, plus any accumulated loss, just to recover one unit of your initial margin! It should not be surprising that the risk-to-reward ratio of this betting method was found to be unacceptably large.

Complex Martingales

The simple Martingales discussed do not present an attractive way of managing risk, however, a slightly more complex form is far more practical and has very different results. Instead of doubling the bet each time there is a loss, as in the case of simple Martingales, increase the bet by a smaller amount, for example, 40%.² This slows down the process and avoids the risk of ruin, or table limits. You may even choose to divide one

bet into more than

1 Roger Altman, "Tactical Trading Revisited," *TecAmical Analysis of Stocks & Commodities* (September 1993).

James William Furguson, "Martingales," *TecAmical Analysis of Stocks & Commodities* (February 1990); and "Reverse Martingales," *TecAmical Analysis of Stocks & Commodities* (March 1990).

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one, so that a situation in which you would trade 8 contracts may be traded in two trades of 4 each. You must simply remember to stop the sequence and begin again when your profits have exceeded your losses. In the following example, each loss is followed by increasing the bet by an equal amount. When a profit occurs, the bet size is reduced by one unit and the sequence ends when there is a net profit. Profits and losses are equal to the bet size.

EXAMPLE 1 Equal-Size Bets with Equal Payoff

<i>Bet</i>	<i>Amount</i>	<i>Result</i>	<i>Net Profit or Loss</i>
#1	\$500	Loss	-\$500
#2	\$1,000	Loss	-\$1,500
#3	\$1,500	Loss	-\$3,000
#4	\$2,000	Profit	-\$1,000
#5	\$1,500	Profit	\$500

In Example 1, it was necessary to win twice to realize a profit the size of the original investment; however, that profit could be achieved with 40% winning trades and 60% losing trades.

Applying this strategy to a more realistic trading profile, consider a system with an average loss of \$1,000, an average profit of \$2,000, and a win to loss ratio of 1 to 3. This means that there are 2 losses and 1 profit in every 3 trades, a net system result of zero, equivalent to a gambling situation. Example 2 shows another sequence of trades. Even though there are 3 losses to start, a single win nets a profit for the sequence.

EXAMPLE 2 Equal-Size Bets with a Trading System

<i>Bet</i>	<i>No. of Units Bet</i>	<i>Result</i>	<i>Net Profit</i>
#1	1	Loss	-\$1
#2	2	Loss	-\$3
#3	3	Loss	-\$6
#4	4	Profit	\$2

When applying a more complex form to reverse Martingales, it is best to target sequences of profitable runs that are likely to occur with reasonable frequency. Instead of betting the entire accumulated profit on the next trade, bet a fixed percentage of those profits. Alternatively, if you are looking for profitable runs of 4, remove the amount of the initial bet from the total bet after the system has returned two profits in sequence. This tends to conserve capital but slows down the process.

SELECTIVE TRADING

It may be unrealistic to think that you can always follow a technical, fully automatic system without manual intervention. Overriding system signals may occur for reasons of sound risk management during a crisis period when you feel that the system is not programmed to deal with the current volatility and that a conservative action is the best business policy.

The beginning system trader often has concerns that the impersonal buy and sell orders will not react properly to the underlying forces that are driving prices. This can

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cause the trader to override the system signals. For example, if the program is geared to take profits after a move of 2%, the trader might judge that the current price move is going to continue; therefore, he will hold the trade rather than take profits. The application of this special intuitive filter generally favors holding a position through ups and downs until it shows a profit, rather than applying consistently good risk management. Judgment tends to interpret all news in favor of the position being held until it shows a profit. A trader who will survive must learn not to take a loss personally, to keep losses small, to establish and stay with a trading plan, and to filter out unsupported opinions. Trading is a business, and business principles must apply.

Technical systems can be taken to extremes in an effort to automatically select only profitable trades. Two approaches to this are most common. The use of more than one trend indicator, such as two moving averages, is one method of isolating the best trend. It is intended to find a smaller piece of a trend that is more reliable or one that performs better than a single, longer trend. In principle, it is no different from using three, four, or more trends of different periods to isolate the one point of a price move that always generates profits. As you become more and more selective, you will find that your opportunities have disappeared, you have used your capital poorly, and the performance profile has actually deteriorated. Using multiple trends, just as any system with many rules, is another attempt at perfection, but only succeeds at overfitting the problem.

There are many systems that can be bought that promise profits. Trying to incorporate a blackbox approach, a method that does not disclose its exact rules, to improve the performance of your own program is not a good idea. Without knowing everything about the other system, there may be inadvertent duplication of a faster trend, a 3day cycle, or some other feature. You may think that an analysis of the correlation of results between the blackbox system and your own method will show if the methods work

well together, but there are still too many uncertainties. The unknown system may have been overfitted and will not show its real risk, or it may have a particular weakness to a market pattern that has not occurred during your testing period. You must understand every method that you trade. It's your risk.

The best way to create a successful trading system is to look for unique elements, each with a sound basis, and combine them one at a time, testing each to be sure they successfully stand on their own. The selection of the speed of a moving average will be more important than either the smoothing technique or the number of moving averages to be used. There may be an advantage to the double moving average approach, but a third, fourth, and so on, lose their significance. A momentum indicator bears a close resemblance to a moving average when its rules are to buy or sell in the direction of the price move, especially when it crosses the zero line. Both have great similarities and will not offer much diversification when applied to the same data. Each system building block should be fundamentally different. A technique, such as a breakout method, that does not depend on time would be a sensible complement to a moving average, which is driven by time. The more complicated cycle and wave theories, contrary opinion, and other methods all view price movement in a completely different way than a moving average, even when applied to the same data. The same moving averages may make the most sense when you apply the same period to different types of data, such as volume and open interest, or compare two related series, such as the Swiss franc and German bund exchange rates.

Filtering is a tool not restricted to price analysis, but applicable to money management, reliability, risk, portfolio selection, and other aspects of a trading program. Selection of which markets to trade and position size is as important as the buy and sell signals. If the system itself corrects for highvolatility markets by decreasing the distance of the stoploss point (keeping the risk constant), it would be redundant to trade fewer positions of that market, thereby reducing the effects of any profits or losses relative to other items in a portfolio.

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SYSTEM TRADEOFFS

Although traders are continually searching for a system that has no losses, they are realistic enough to know that most profit, loss, and risk decisions are dependent on one another. Just as in Gambling Theory a system can be structured to have frequent small losses and occasional large profits or frequent small profits with some large losses. It is simply not possible to create a system with such small losses that these losses are essentially zero without increasing the frequency of the losses to the point at which profits rarely occur. In short-term or high-leveraged trading, the cost of doing business prevents such an approach from working.

The basic principles of systematic trading require that the trader choose between the frequency of profits to losses, the relative size of those profits and losses, and the number of opportunities that will be available to trade. These interrelationships will be different for various types of

systems.

TrendFollowing Systems

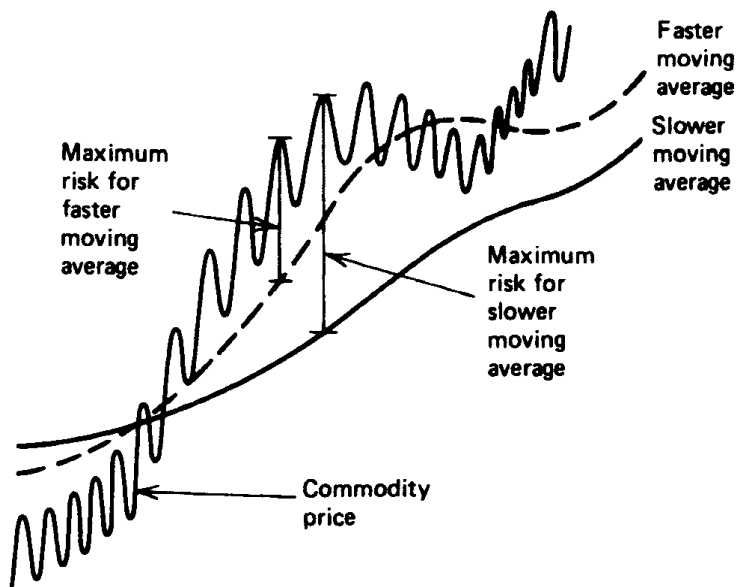
The relative risks and rewards of a trendfollowing system are based primarily on the selection of the trend speed. As an example, using a simple moving average system applied to closing prices, Figure 227 shows that a faster moving average (smaller number of days) will stay closer to the current price than a moving average that uses a larger number of days. The maximum risk is equal to the largest lag, as measured from the current price to the corresponding moving average value. This lag is limited by:

$$M = P (L \times N)/2$$

where P is the current closing price, L is the limit move or 3 standard deviations of the average daily true range, and N is the number of days in the moving average.

The smaller losses of the faster trend system are kept in proportion to the profits because of the relative system sensitivity. The price changes of smaller magnitude, which cause the moving average to change direction and hold losses to a minimum, also break the sustained trends into shorter movements. The net results are more frequent trades with relatively small losses and modest profits. Longerterm trends cause fewer trades by

FIGURE 227 Relative risk of a moving average system.



holding to the market direction for a longer time. This results in larger profits and correspondingly larger losses.

The risk of a single trade being small or large is not a complete measure of trading risk. Because there are more losses than profits in normal trendfollowing systems, it is important to consider the sequence of losses as part of the ultimate risk of trading. It is the aggregation of these

losses that provides a reasonable comparison in determining whether a slow or fast moving average system has the best profit to loss ratio.

The feature of a trend system that is most appealing is the small losses relative to large profits. This feature also causes frequent small losses during sideways markets, and the number of these false signals cannot be significantly reduced simply by using a longerterm trend. Testing will show that there is always some sideways price movement that coincides with the trendline, resulting in a high percentage of whipsaw losses. It is unrealistic to expect a smoothing technique to produce more than 40% to 45% profitable trades.

Countertrend Systems

The risk and reward structure of a countertrend method is different from that of a trendfollowing approach. Although the size of your profits and losses relates to the time period of analysis in a manner similar to trend following, positions must be set in advance of an expected price reversal. This clearly introduces more risk and makes the success of the method dependent upon good timing. When countertrend methods are discussed here, those techniques that require a confirmation (i.e., they wait until prices reverse their direction) are not included as countertrend systems.

Due to the greater risk of a countertrend system, its objectives are generally well defined. In a trend system you let the profits run until prices reverse; however, most countertrend methods rely on an oscillator, contrary opinion, or an overbought/oversold analysis, and set goals for exiting when the overbought or oversold condition disappears. This results in a profile that limits profits; therefore, it should not also limit losses.

TradeOffs

The selection of a performance profile goes together with particular trading styles. Some combinations are entirely incompatible. Ideally, you would want very large profits, high reliability, and small losses. Unfortunately, these combinations are not possible. The tradeoffs that are readily available are:

1. A few large profits and frequent small losses
2. Many small profits and a few large losses
3. More opportunities with greater risk
4. Fewer opportunities with less risk

It is easy to identify the first combination with trend following. To have fewer losses you must allow greater risk. Keeping losses small means being stopped out because of market noise rather than underlying trend; therefore, you can expect many more losses than profits. In the case of a countertrend system you might profit from market noise, which accounts for a large percentage of the price variability. The moves caused by market noise are also much smaller and more frequent than trend moves. To profit from noise you must enter the market while prices are going in the opposite direction, as in a countertrend technique, and allow more risk. This causes the profile in option 2, many small profits and a few large losses.

The last two choices are the result of a random distribution of price moves. if you look back at the study of runs, you will remember that price changes exhibit a pattern very similar to random movement. For every 100

days of prices, there will be 50 days in which prices

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reversed after only 1 day of up or down movement, 25 days of price movement in the same direction for 2 consecutive days, 12.5 days for 3 consecutive days, and so on. Although real price patterns may vary slightly from that distribution, they are very close. For any fixed time period, these patterns remain the same; that is, there are always more opportunities for smaller moves than larger ones. To hold a trade for the long term, you must be able to withstand all of the market noise that might occur during that period. The longer you hold a trade, the greater chance you will see larger market noise, or adverse price moves.

You can see how this applies to a countertrend trading using a typical price oscillator. Figure 228 shows the fluctuations of a sideways market, one that has no trend bias. Assuming that there is a normal distribution of prices, there is a clustering near the center and less frequent peaks and valleys as prices move further away from the middle. Construct an overbought/oversold indicator, which can be categorized as slightly (S), moderately (M), or extremely (E) overbought or oversold, by drawing lines on Figure 228.

It can be seen that there are more opportunities to buy a slightly oversold market and sell a slightly overbought market; all prices must pass through the area closest to the center before reaching a more overbought or oversold condition. Therefore, the opportunities must increase as profit goals decrease. But what about the risk? If profits are limited, risk must be restricted to a small part of the potential profits, or not limited by a dollar amount but by a patterned condition. In this countertrend system example, an attempt to make losses small relative to profits entered during the slightly oversold zone would cause the number of losses to increase dramatically, overwhelming the potential profits (seen in Figure 228). If losses are not restricted, they will be larger when there are more opportunities with smaller price objectives, and smaller for the fewer cases when prices are in the extreme zone. The minimum risk occurs on a single trade taken at the absolute extreme points. Figure 229 shows the relationships that exist in a standard countertrend system.

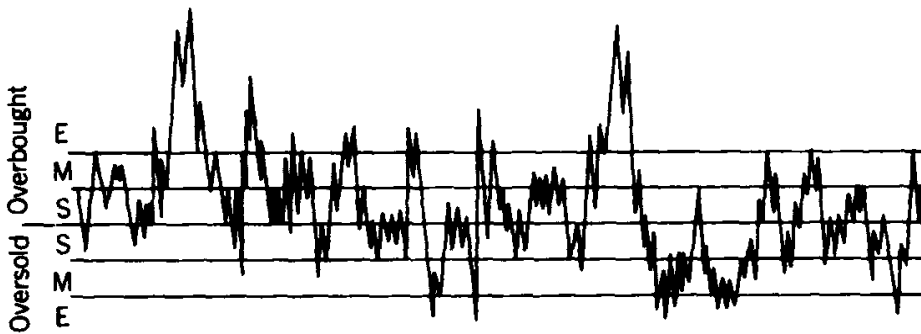
All systems have tradeoffs. To reduce the losses, either the profits or the frequency of opportunities must be reduced whether the trading approach favors the trend or countertrend. A trend follower looking for the big move must also take a big risk. In the development of a system or trading philosophy, personal preference determines the combination of risk, reward, and opportunity.

The Commodex Method of Combining Elements

The Commodex system was first presented in 1959 and is still active, published daily by *Commodity Futures Forecast* in New York. Commodex combines the components most acceptable to the experienced trader in a unique weighting method. It includes moving averages, price momentum, and open interest to calculate a trend index.

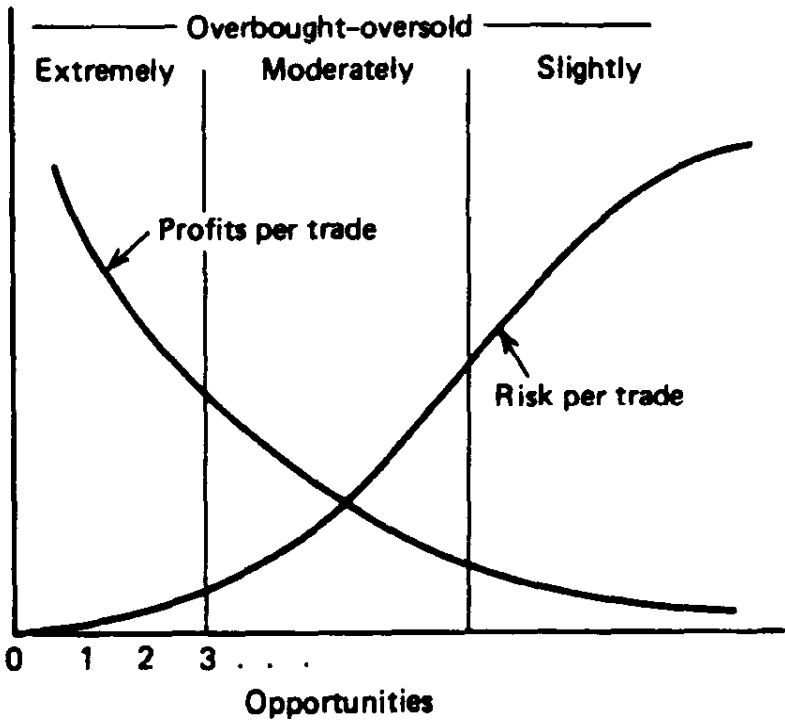
The most interesting aspect of the Commodex system is its ranking process, intended to produce a relative strength value for each trend. Using

a 10 and 20day double mo .
FIGURE 228 Countertrend alternatives using detrended price series.



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FIGURE 229 Relationship of profits to risk per trade based on opportunities.



average, the system scores the current market performance to establish the value of the trending component. Bullish and bearish values are calculated by looking at three situations independently: the simple moving average signals derived from both the long and shortterm trends, and the double

moving average signal generated by combining the two trends. The two techniques of single and double moving averages are exactly as treated in Chapter 5. The most important of the three factors is the longterm trend; second is the shortterm trend, and last the relative position of the fast to the slow moving average. The strongest upwardmoving trend is generated when current prices are above both the faster and slower moving averages and the faster average is below the slower. The opposite positions would result in the strongest downwardtrending component. Trends are considered neutral if the most important element, the longterm moving average, conflicts with the other two factors.

The rate of change in open interest is considered a secondary reinforcement of the trend. Using a concept different from the usual charting techniques, Commodex considers it a bullish sign if there is an increasing growth momentum in open interest combined with rising prices. The growth momentum is the difference between the rate of increase of the open interest and the 20day moving average of the open interest. Continuing a bull move with rising prices and rising open interest is a classic concept of charting. The bear move is confirmed with rising open interest and falling prices. Commodex also considers a drop in open interest along with falling prices to be a bullish factor. The movement of volume is treated in the same manner as open interest and can confirm a bull or bear trend. An increasing volume momentum with rising prices is support of an upward move; other combinations indicate bear trends.

Added together, the signals are ranked from a strong buy to a strong sell with lesser degrees in between. The system must be given credit for the quantification and balancing of these elements, which are generally treated as highly interpretive charting techniques. The rules for applying the daily signals to trading combine both the individual strength of the signal with the movement of the Commodex trend index. The trend index itself acts as an overboughtoversold indicator, encouraging profits at specified levels and considering a position reversal in more extreme situations; stops are placed using the 20day moving average with predetermined band penetrations. Additional objectives are based on the

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profits accrued from a trade, with a 50% return justifying a protective stop on part of the positions, and a 100% profit requiring the liquidation of half the position. These money management concepts are an important aspect of any system and tend to round out Commodex.

The Commodex system has been used as an example of combining techniques that have been studied individually in previous sections. It is important to see that each element is simple to understand and avoids duplication; it has single and double moving averages (with and without bands), momentum indicators derived from volume and open interest, an overboughtoversold indicator formed from a combination of an elements, trading stops, and liquidation based on money management and inverse pyramiding.

Combining Trends and Trading Ranges

Trends and trading ranges account for most price movement; a

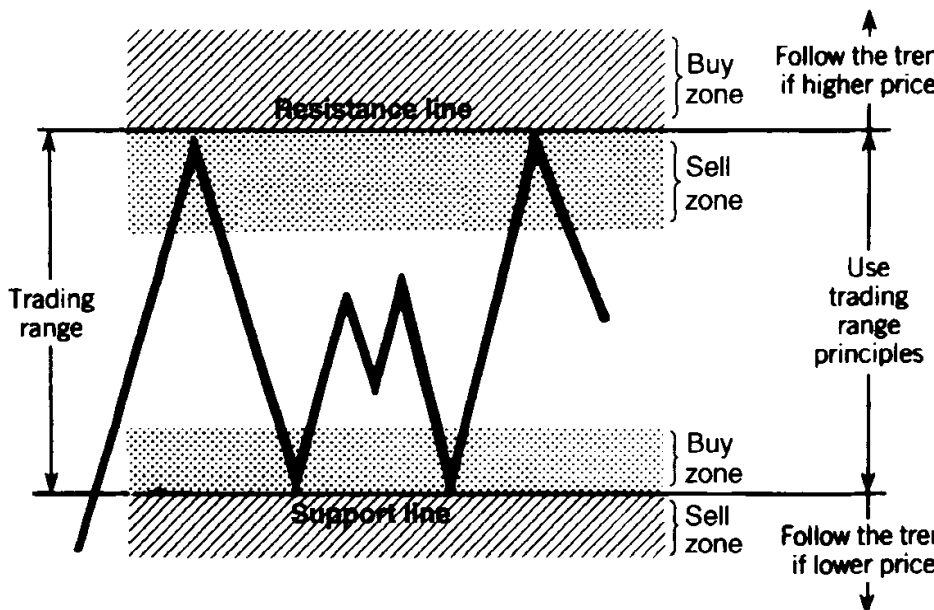
small percentage cannot be identified. Most traders must decide whether they intend to profit from trend moves or sideways markets and then develop techniques that target that objective. A trend is concerned with the periodic tendency of prices to move in one direction without a limiting objective, and a trading range is a definition of price containment. The role of time is different for the two approaches. The trend is expected to advance with some regularity over time, while prices within a trading range can move in any direction with varying speed, providing the upper and lower bounds are not violated.

Trading ranges and trends take turns dominating price movement, with the trading range most common. Longterm trends are easy to see, as for example, represented in the buying power of the U.S. dollar and the Consumer Price Index. When there is no actual or anticipated change in fundamental factors, prices fluctuate in a restricted range, bounded by support and resistance levels. The top of a trading range is often wider than the bottom because of the inherently greater volatility at higher prices; but even with the broader formation, there is a clear point at which prices have gone higher and are no longer within the trading range.

It often happens that the two techniques of price trend and trading ranges are in conflict: The trend is up and a resistance level is encountered, or the downtrend is stopped by a support level. Established support and resistance levels cannot be ignored, neither can a major trend; it makes sense to combine both features. The simplest way is to use the trading range while prices are within that area and follow the trend when prices break out either above or below (Figure 2210).

The exact rules depend on the size of the trading range, the speed of the trend, and whether the support and resistance levels have been established over time. Recent range formations offer less of an obstacle than those that have survived for some time. If the range is narrow, a moving average buy or sell signal invariably occurs at the resistance or support level and is met with an initial reversal. For a larger range, a mediumspeed moving average signal may occur closer to the center of the range and allow some opportunity for trend profit before resistance is encountered. For very wide ranges, there may be ample latitude for a moving average to signal entry and closeout without the interference of support and resistance levels. One method of combining the two techniques is to use whichever signal is generated, regardless of the system. The following combinations of short position entry and exit are possible for medium to wide ranges:

1. Enter a new short position when the moving average turns down.
2. Enter a new short position when prices enter the sell zone around the resistance level.
3. Enter a new short position when prices fall below the support area, then close out the short position when the moving average turns up.



4. Close out a short position when prices enter the buy zone above the support level.
5. Close out a short position when prices break through a resistance level moving up.

The same rules apply in reverse for long positions. The advantage of this filtering method is that new short trades are not entered at support levels, which causes immediate losses or prolonged trades of little result.

TRADING LIMITS A DAMPENING EFFECT

The existence of trading limits in some of the U.S. markets has always been the concern of novice speculators who seem convinced that their first entry into the market will result in an adverse locked limit move, stripping them of their future and happiness overnight. There is no doubt that many people have suffered from being caught on the wrong side of a move, but trading limits would tend to protect rather than harm them. The limits established by the exchanges are intended to allow free trading within the normal range of price fluctuation. While the agricultural markets still have traditional daily limits, the financial markets have gone to a system of suspending trading for a short period, then reopening with larger limits. If properly established, these limits should rarely be reached. As prices rise, the volatility of the market increases, and so the limits must be expanded to correspond to the new price range. At this point, trading risks become proportionately greater and margins are raised.

The purpose of limits is to prevent an immediate reaction to unexpected news from moving prices to unjustifiable levels. The first reaction to bad news is usually more extreme than is realistic, and when proper assessment of the problem is completed, the results are rarely as bad as initially thought. Limits also serve to give the losing trader more time to

capitalize the position, or meet a margin call, rather than be forced to liquidate.

Frequency of Limit Moves

Sugar prices, which had a spectacular rise in 1974, can serve as an extreme case of changing volatility. Beginning in 1969, Table 224 shows the remarkable price move seen in the frequency of limit moves. The contracts shown have no duplicate dates and do not include the actual delivery month.

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TABLE 224 Frequency of Limit Moves

	<i>Total Days Examined</i>	<i>Days Closing at Limit</i>	<i>Percentage of Limit Closes</i>	<i>Range of Closing Prices</i>
Sep 70	248	0	.0	2.91-4.01
Sep 71	249	0	.0	2.74-5.08
Sep 72	240	18	7.5	4.26-9.17
Sep 73	239	9	3.8	5.44-10.50
Sep 74	239	40	16.7	7.56-28.15
Sep 75	239	54	22.6	11.51-50.82
Sep 76	238	3	1.3	12.07-18.65

The obvious conclusion to be drawn from the pattern of the sugar market is that limits did not expand quickly enough at higher price levels. In 1975, 22.6% of all trading days closed at the limit; at low price levels, the limits were of no consequence. The 1974 price of sugar increased by 15 times its 1969 price, while the limits only expanded from 50 to 200 points, a factor of four. Limits present a problem for a trading system because they artificially alter the volatility of the market. The consolation is that a trading system is useless in a market that is lockedlimit for a week. You might find it enlightening to test your system on a market and period where limit moves were evident to see their effect on signals and performance.

The only realistic way of comparing the effects of limit moves against a limitless market is to compare the U.S. and London exchanges. Using the May 77 Coffee contract for the month of February 1977, we can show three separate examples of limit moves in the U.S. contracts and the corresponding London action. Figure 2211 illustrates the closing prices of the two markets on the same day. Two problems must be considered: the conversion of sterling to U.S. dollars, which was fixed at \$1.70 for the entire comparison, and the overlapping hours of the New York Coffee and Sugar Exchange and the London Sugar Exchange. The exchange hours may have some difference in the daily price but should not appreciably affect the comparison.

The first U.S. lockedlimit day was on February 7, when the NewYork coffee prices for the May 77 contract moved to 230.82 (up 300

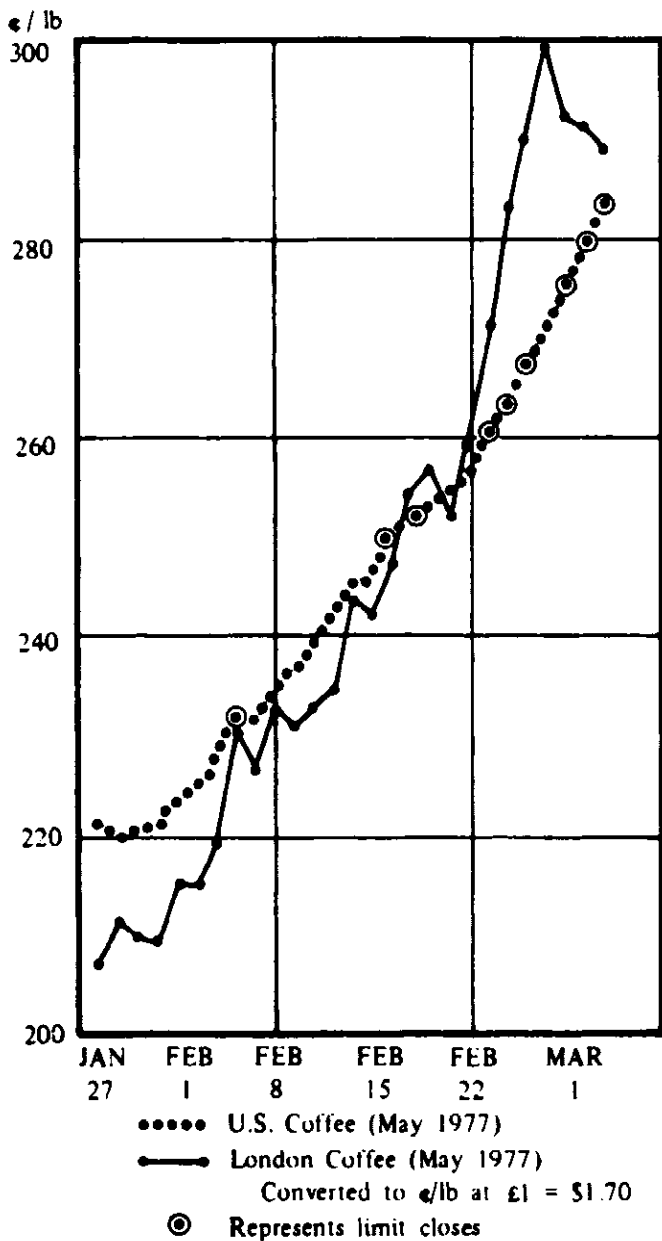
points). On the same day, London prices for the May 77 contract moved from 218.80 to 230.56 (actually 2883 to 3038 sterling). A trader who closed out his position on the open in the London market would have taken a flu of 2850 and a loss of 12.67 cents per pound relative to the U.S. market. The traders locked into their New York position could have gotten out on the open on February 8 at 233.50, a loss of 568 points. Had both the U.S. and London traders waited for the closing prices as shown in Figure 229, the corresponding losses would have been reduced to 1176 points in London and 318 points in New York.

The second case was on February 17 and 18 when the U.S. market stayed locked at the limit for 2 days. A trader entering the market in London on the prior day at 241.91 (3187.50 sterling) could have gotten out on the next day at 247.07 (3255.07) for a loss of 516 points. The corresponding New York trader would have entered at 246.00 and exited at 254.50 for a loss of 810 points.

Remarkably, the London coffee prices had moved to 2 52.04 by the time the New York market was trading again. London prices had gained 1013 points during the time that a locked limit U.S. market gained only 850 points. In both cases, the volatility of the London market with no limits was much greater than the U.S. equivalent, and the results do not show any disadvantage to trading limits.

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FIGURE 2211 Comparing limit moves in U.S. and London coffee markets.



The third case of lockedlimit moves began on February 24. On the day prior to the first lockedlimit day, the U.S. market traded actively even after the London Exchange moved up an equivalent of 698 points. There should have been ample time that day or even the prior day, when the U.S. market traded at the limit but closed lower, for any trader to exit an undesirable

position. Figure 2211 shows the larger moves of the London market peaking and starting down to meet the plodding U.S. prices. The market with no limits has overreacted to the bullish news by at least 1,000 points. Of course, for traders who didn't get out of New York coffee soon enough, the overreaction of the London market was not very gratifying.

Changing the Rules

Due to the frequency of locked limit moves during the exceptional periods, and the need to keep changing them as inflation forced prices higher, most exchanges have changed the way daily trading limits are established. At one time, an exchange committee was convened to review limits; now, limits automatically expand to meet conditions. The S&P, along with some other financial markets, have circuit breakers that cause the market to halt when specific limits are reached. After a short pause they reopen and can trade to new levels before another circuit breaker is activated. At an extreme level, however, the S&P will also stop trading, putting it in the same situation as New York coffee versus London coffee. The years have changed but the problems remain the same.

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The normal policy for agricultural markets is that, following a trading day in which prices closed at the limit, limits expand to 1 1/2 their initial value. They may remain at this level for 1 or 2 days, provided prices continue to close at either limit (higher or lower). Limits will then expand to twice the initial range; if a locked limit move persists, limits are entirely removed for 1 day. After this, or after any day that prices do not close at the limit, the pattern begins again with the initial limit value. Occasionally, the initial value may be altered by the exchange.

GOING TO EXTREMES

In 1974, public awareness of inflation caused an overwhelming interest in all forms of hedging, with large numbers of naive investors purchasing silver and gold as currency protection. Many sophisticated investors turned to the futures markets, which offered leverage on their purchases; some learned how to use the markets themselves and others relied on advice.

One investment system that was sold at this time was more of a leveraged substitute for the purchase of bouillon than a trading strategy. At the time it was published, it had always worked the sponsor of the system stood behind it with his reputation. The rules of the system were:

1. Trade silver futures because of their intrinsic value, historic performance, potential, and fundamental demand with short supply.
2. Use the futures contract between 3 and 7 months from delivery to combine the advantages of liquidity and duration.
3. Always buy, never sell, because it is always successful.
4. Buy whenever you like. Although any sophisticated method can be used, it won't matter in the long run any guess will do just as well. Follow the same method for adding to positions or reentering after closing out a trade.
5. Close out the position when there is a profit, not before.
6. Meet all margin calls don't let the market beat you.

7. Invest \$5,000 per contract (5,000 troy ounces). This will allow a \$1 per ounce adverse move (silver was at \$4.50 per ounce).
8. Whenever you need reinforcement, reread the reasoning behind this system.
9. Do not let anyone or anything interfere with following this system.

How did the investors do? It depended on when they started. Entering in the first half of 1975, shortly after the system was released, showed individual contract returns ranging from profits of 5 to 10 to losses of 180 per ounce. A drop in silver prices then produced losses of up to \$1.02 per ounce for the next 9 months (slightly over 100%), followed by a 2-month rally, and losses again. This system would have worked from 1979 to February 1980 and then lost for the next 15 years. An investor following these rules, entering at a chance place would have had more than a 10:1 likelihood of losing. Any profit made would have been given back if the investor persisted in following the method.

In trying to understand how a system such as this can have a chance of reaching the public, remember the time in which it was introduced. With prices increasing drastically, food shortages, and publicity over the devaluing U.S. dollar, the rationale of the system seemed justifiable. There was serious talk about leveraged inflation funds using futures. These systems fill an immediate need, without regard to long-term consequences. There is no doubt that, if high inflation returns, systems just like this one will reappear. Given the bull market in stocks for the past 20 years, it is surprising that more of these systems are not in evidence. With only small changes in the nine rules for trading silver, we could create a scenario that would be very believable to many people looking to enter the stock market.

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SIMILARITY OF SYSTEMS

A primary concern of both the government regulatory agency (CFTC) and individual traders is the similarity of computer-based systems that are used to manage large positions. If the propagation of technical trading systems has similar foundation and testing methods, it is possible that many of them will produce buy and sell signals on nearly the same day. That is, these systems may appear different in their rules and parameters, but they could be essentially quite similar to many people looking at the same markets and using the same tools.

First, consider the extreme case in which two systems with the same trend-following philosophy have the same profit over the same period of time. Will the signals occur on the same day? Are they on the same side of the market most of the time? Figure 2212 shows one combination that has a low correlation given this situation.

System A is a slow trend-following method, which avoids the choppy markets but nets only a small profit. System B jumps in and out, capturing profits quickly but with frequent losses. They both return the same profits. System B is on the same side of the market as A about 50% of the time because the overall trend was up; therefore, it cannot be negatively correlated, but it could have a low positive correlation. If system B were not as fast as in this illustration, the positive correlation would be greater.

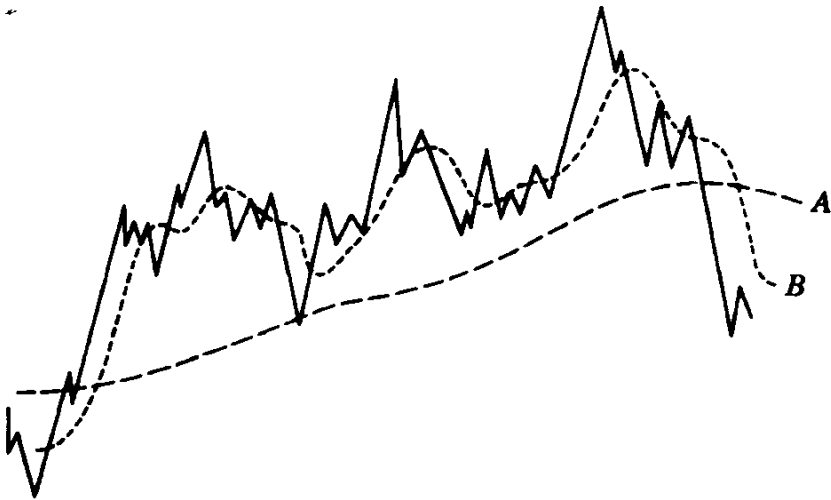
As the time periods used for calculation become closer, the correlation increases.

if computerbased, trendfollowing systems with different calculation periods are not highly correlated, then it is possible to reduce portfolio risk by trading a variety of different techniques and time periods; however, the reality of the issue may be different from the theory. Lukac, Brorsen, and Irwin' performed such a study. They compared 12 popular trading techniques (mostly trendfollowing) over 12 varied futures markets for the years 1978 to 1984. Each system was optimized, using 3 years of data, and the best parameters used to trade the next year. The systems selected were

1. Cbannel systems
 - a. Closing price channel (CHL)
 - b. MII price channel (MII)
 - c. LS0 price channel (LSO)

Louis P Lukac, G. Wade Brorsen, and Scott H. Irwin, Similality of Computer Guided Tecimical Trading Systems (CSFM124, Working Paper Series, Columbia Futures Center, Columbia University Business School, New York. March 1986). Also by the same authors, "Do similar signals from trading systems move prices?" Futures (November 1987).

FIGURE 2212 Two trendfollowing systems with low correlation.



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2. Momentum/oscillators
 - a. Directional indicator (DRI) b. Directional movement (DRM) c. Range quotient (RNQ) d. Reference deviation (REF)
3. Moving averages
 - a. Moving average with percent band (MAB) b. Dual moving average (DMC)
4. Systems with trailing stops
 - a. Parabolic Time/Price System (PAR) b. Alexander's Filter Rule (ALX) c. Combined Directional Movement and Parabolic Time/Price

System (DRP)

The study used three measures to test system similarity:

1. The percentage of the time that systems are on the same side of the market (long or short)
2. The percentage of buy or sell signals that occurred on the same day, or within a few days of one another
3. The correlation of aggregate monthly portfolio returns

The results show a significant positive correlation in the system profitability (Table 225). However, there is no pattern that shows that one particular type of system is notably more correlated than others. The Parabolic and Directional Parabolic systems are most similar because one is based on the other.

Only four of the systems were significantly profitable: CHL, MII, DRP, and DMC. The correlations of those systems do not seem any more significant than others that were not profitable. In Table 226, the percentage of trades that occur on the same day is very low. A more informative comparison is seen in Table 227, which tallies the percentage of days that each system held the same position. This last table is a practical way of finding the performance correlations.

TABLE225 Correlations of Aggregate Monthly Returns from 12 Systems

System	Trading System							
	CHL	PAR	DRM	RNQ	DRP	MIJ	LSO	REF
PAR	0.57							
DRM	0.72	0.61						
RNQ	0.70	0.41	0.70					
DRP	0.65	0.81	0.79	0.57				
MIJ	0.75	0.54	0.67	0.73	0.67			
LSO	0.59	0.43	0.53	0.68	0.54	0.70		
REF	0.55	0.37	0.57	0.66	0.52	0.54	0.60	
DMC	0.72	0.41	0.68	0.78	0.55	0.74	0.58	0.57
DRI	0.71	0.42	0.69	0.77	0.55	0.70	0.59	0.66
MAB	0.72	0.55	0.75	0.74	0.69	0.69	0.63	0.60
ALX	0.58	0.55	0.62	0.55	0.57	0.57	0.58	0.51

All coefficients significant at the 0.01% level with the exception of REF and PAR coefficient, which is significant

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TABLE226 Percent of Trades That Occur on the Same Day

System	Trading System								
	CHL	PAR	DRM	RNQ	DRP	MII	LSO	REF	DA
PAR	19*								
DRM	25**	21**							
RNQ	22**	9	15						
DRP	30**	93**	48**	10					
MII	20*	15	10	28**	17				
LSO	22**	13	17	27**	18	23**			
REF	12	7	7	11	9	12	14		
DMC	16	6	8	28**	6	12	18	19*	
DRI	18	9	14	38**	10	32**	22**	15	25
MAB	28**	18	23**	23**	27**	18	25**	11	19
ALX	12	20*	12	19*	20*	9	17	10	10

Percent of trades that occur on the same day by each pair of systems. Significance assuming a binomial distribution, confidence limits and ** denoting 99% confidence limits.

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The study concludes that computerbased systems trade on the same day significantly more often than would randomly be expected, but the actual percentage of trades that occur on the same day is small. These systems have the potential to move market prices, but the trades do not often occur at the same time. One must be concerned, however, if trendfollowing systems are holding the same position 75% of the time, they must compete with each other when they exit, even if that occurs over a period of a few days. Trading signals that occur at the exact same time may not be necessary.

Correlation When You Don't Need It

There is often a theoretical answer and a practical one to the same question. There is no doubt that a variety of trendfollowing systems generate trading signals at different price

TABLE 227 Percent of Trading Days Systems Hold the Same Positions

Trading System

System	CHL	PAR	DRM	RNQ	DRP	MII	LSO	REF
PAR	70							
DRM	82	76						
RNQ	75	61	73					
DRP	68	83	75	59				
MII	82	69	80	75	65			
LSO	73	58	71	73	57	73		
REF	72	57	69	69	55	72	69	
DMC	81	62	77	79	61	79	76	78
DRI	70	56	68	72	54	71	69	67
MAB	65	54	66	62	53	63	61	57
ALX	72	64	71	68	59	73	65	67

Percent of the trading days each pair of systems is on the same side of the market (long or short) at the same time, assuming a binomial distribution with 99% confidence limits.

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levels, some nearer to each other and some farther away. During active, high-volume trading periods, a few of these systems can give buy signals without causing prices to move and other trending systems to be triggered. During sessions with light volume, it is more likely that a system traded with a large position will cause piggybacking by others, resulting in a price spike that disappears once all the systems have kicked in.

The worst case is a price shock. Although not caused by systems, all trend systems not holding a position in the direction of the shock will get signals to enter at the same time, the result of a large price jump. The correlations mean very little and only diversification using different trading philosophies, rather than time periods, would help. Although relatively infrequent, large price shocks can be fatal. When designing your trading strategy, keep the practical issues of diversification and risk management always in sight.